RESEARCH

The characteristics and influencing factors of the spatial distribution of intangible cultural heritage in the Yellow River Basin of China

Xin Nie, Yong Xie, Xiaoxiao Xie and Lunxing Zheng[*]

Abstract

This paper explores the characteristics and influencing factors of the spatial distribution of 889 national intangible cultural heritage sites in the Yellow River basin of China based on ArcGIS spatial analysis and Geodetector. The results show that the distribution of national intangible cultural heritage sites in the Yellow River basin is significantly different among provinces, and most of them are distributed in the central and western regions. From east to west, the density of intangible heritage in the Yellow River basin presents a triangular "one area and three points" pattern. All kinds of intangible cultural heritage in the Yellow River basin generally show the characteristic of aggregated distribution.Traditional skills, traditional medicine, traditional theatre, traditional music, and folklore have high levels of agglomeration, and traditional dance, Quyi, folk literature, and traditional fine arts have lower levels. The levels of traditional sports, entertainment and acrobatics have the lowest agglomeration. Among social and humanistic factors, highway density is the most influential indicator for the spatial distribution of national intangible cultural heritage in the Yellow River basin. GDP, population density and the urbanization level also have a great impact on the spatial distribution of national intangible cultural heritage in the Yellow River basin. Among geographical environmental factors, the river system and topography have a certain effect on the spatial distribution of national intangible cultural heritage in the Yellow River basin. Based on these facts, this paper finally discusses the specific path to protect and develop intangible cultural heritage in the Yellow River basin in the context of the newerato promote its creative protection and innovative development.

Keywords: Intangible cultural heritage, The Yellow River basin of China, Spatial distribution, Geographical distribution, Influencing factors

Introduction

The legal system for the protection of intangible cultural heritage (ICH) has become increasingly sound in the 10 years since the Intangible Cultural Heritage Law of the People's Republic of China was enacted. A list of typical ICH sites has also been established, including four levels:the national, provincial, city, and county levels. In 2021, the Outline of the Fourteenth Five-Year Plan for National Economic and Social Development and the

Long-Range Objectives Through the Year 2035, passed by the National People's Congress and the Chinese People's Political Consultative Conference, mention ICH and the development of traditional culture many times and propose that the systematic protection and innovation of ICH should be strengthened. China is paying increasingly more attention to ICH, and more efforts have been made to protect it, which can not only strengthen the systematic protection and people's awareness of protection but also spread the vitality and influence of fine Chinese traditional culture. However, in the process of protection and inheritance, there is still a range of problems that need to be solved, such as the lack of core meanings and

*Correspondence: niexin2005@126.com
School of Intellectual Property, Nanjing University of Science and Technology, Nanjing 210094, People's Republic of China

Nie *et al. Heritage Science* (2022) 10:121

Page 2 of 16

different forms of development. Therefore, based on the collection of Chinese intangible cultural heritage in the Yellow River, the use of geographic information technology, analyzed its geographical distribution, analysis of the intangible cultural heritage in the Yellow River basin of geographical spatial distribution characteristics and influencing factors, the spatial distribution of intangible cultural heritage in the research. Based on research on the spatial distribution of ICH, this paper analyzes the relevant influencing factors and then plans a reasonable layout to achieve the development and inheritance of regional ICH.

Research review

The worldwide emphasis on ICH has attracted the attention of scholars. Most of the early studies focused on the concept and connotation of ICH, the relationship between it and human life, its utilization and value assessment, the conservation concept, tourism development, and other aspects, obtain ingrelatively rich research results. These phased studies explored the extension and connotation of ICH from the external level to the internal level [1–4].

In recent years, research on ICH has not been limited to the primary level of concept definition, type division, inheritance, and protection, and it has begun to explore in depth issues. theoretical discussions and construction research have been conducted, protection systems have been proposed, reflective and suggestive research has been performed, protection and management experience has been analyzed, and the impact of the declaration of ICH on local economic and social development as well as the reconstruction and re-innovation of ICH have been studied [5, 6].Studies have ranged from every continent to specific villages [7, 8]. However, most of these studies are aimed at specific types of ICH, and there are relatively few comprehensive studies on its characteristics in a whole region [9]. The research methods mainly include case analysis, model construction, historical literature retrieval, and sample surveys [10, 11].

Research on ICH in China is mostly carried out from the perspectives of tourism, anthropology, education, and other disciplines. With the enrichment of qualitative research, scholars are gradually paying attention to the combination of its protection and geographical science and are carrying out quantitative research on ICH. In recent years, many scholars have also paid attention to the spatial distribution characteristics and influencing factors of ICH, which is an important way to improve its management and protection level in China [12]. However, from the perspective of the research area, current research is mostly based on a certain province, and there is less overall research on specific areas [13–17].

From the perspective of research categories, studies mainly focus on a specific type of ICH object. Regarding research methods,qualitative analysis is mainly used, which is carried out based on the sequence method, spatial autocorrelation, point pattern analysis, hot spot clustering, and other aspects. There are few quantitative case and empirical studies and few quantitative studies on the influencing factors of its regional scale and spatial distribution, especially research on the interactions between influencing factors.

Due to the vast territory and abundant resources in China, there are certain differences in natural conditions and cultural environments in different regions, and the distribution of ICH varies from place to place. At present, in domestic regional research, there are very few studies on ICH in China's Yellow River basin, which is an important birthplace of Chinese civilization and cultural region in China. This paper focuses on the distribution of ICH in China's Yellow River basin and uses ArcGIS software to graphically illustrate the spatial structure, pattern, and principle of ICH in this area, revealing the spatial distribution characteristics based on two aspects, i.e., the overall and type differences, methodologically through the concentration index, the nearest neighbor distance and kernel density to explore the influencing factors of its spatial distribution and the interactions through the use of Geodetector. The purpose is to provide a scientific basis and reference for the government to grasp the spatial distribution characteristics and principles of ICH resources in China's Yellow River basin, optimize its protection and tourism development, formulate targeted and efficient protection measures, and provide effective opinions for the protection and development of ICH resources in China's Yellow River basin.

Research data and methods
Study areas and data sources
The Yellow River, the second longest river in China and the fifth longest river in the world, gave birth to fine Chinese traditional culture,witnessinga brilliant civilization for more than 5000 years. Taking the Qinling-Huaihe River as the boundary, China can be divided into South China and North China, and based on the level of economic development and geographical location, China can be divided into three regions: eastern, central, and western [18].Therefore, geographically, the Yellow River basin is mainly located in North China, stretching across the eastern, middle, and western areas and passing through, from west to east, the Qinghai-Tibet Plateau, Inner Mongolian Plateau, Loess Plateau and Huang-Hai Plain. The Yellow River, originating from the Bayan Har Mountains in Qinghai Province, China, runs through Qinghai, Sichuan, Gansu, Ningxia,

Nie *et al. Heritage Science* (2022) 10:121

Page 3 of 16

Inner Mongolia, Shaanxi, Shanxi, Henan, and Shandong and finally flows into the Bohai Sea in the Kenli District, Dongying city, Shandong Province.

As shown in Fig. 1, to be clear, this paper does not include data on Sichuan, even though the Yellow River flows through it. The reason is that the main channel in Sichuan is 174 km long, passing only through Aba, Hongyuan, Ruoergai, and Songpan counties in northern Aba Prefecture and Shiqu county in Ganzi Prefecture, while the ICH in Sichuan is mainly distributed in the south-central area and has little connection with the Yellow River. The inclusion of data from Sichuan can influence the findings.

The data in this paper come from the website ichchina.cn and the fifth list of national intangible cultural heritage sites released by the State Council on May 24, 2021. The statistics indicate that there are 889 ICH sites in the Yellow River basin (including expanded sites), and they can be divided into ten types by Chinese standards. Table 1 shows the results.

Research methods

Concentration index

The Lorenz curve and concentration index illuminate the aggregated distribution of national ICH among specific types [19]. The formula for the concentration index is:

$$I = \frac{A - R}{M - R}$$

In this formula, A represents the sum of the cumulative percentages of the actual distribution of ICH types; R represents the sum of cumulative percentages when the types of ICH are evenly distributed; and M represents the sum of cumulative percentages when the types of ICH are centrally distributed. The range of *I* is 0 to 1. The closer the value of *I* is to 1, the more concentrated the ICH sites are in certain types. The closer the value of *I* is to 0, the more evenly distributed the ICH sites are among the ten types.

Nearest neighbor index

Taking ICH protection units as the location of ICH sites, this paper studies the geospatial distribution of national ICH sites by calculating the nearest neighbor index and gives an overall evaluation of its discreteness or concentration [20]. The formulas are as follows.

$$ANN = \frac{\overline{D}_o}{\overline{D}_E}; \quad \overline{D}_o = \frac{\sum_{i=1}^{n} d_i}{n}; \quad \overline{D}_E = \frac{1}{2\sqrt{n/A}};$$

In these formulas, *ANN* represents the average nearest neighbor ratio; $\overline{D}_o$ represents the average distance between the nearest ICH sites in reality; $\overline{D}_E$ represents the average distance between the nearest ICH sites assuming that ICH is randomly distributed; *n* represents
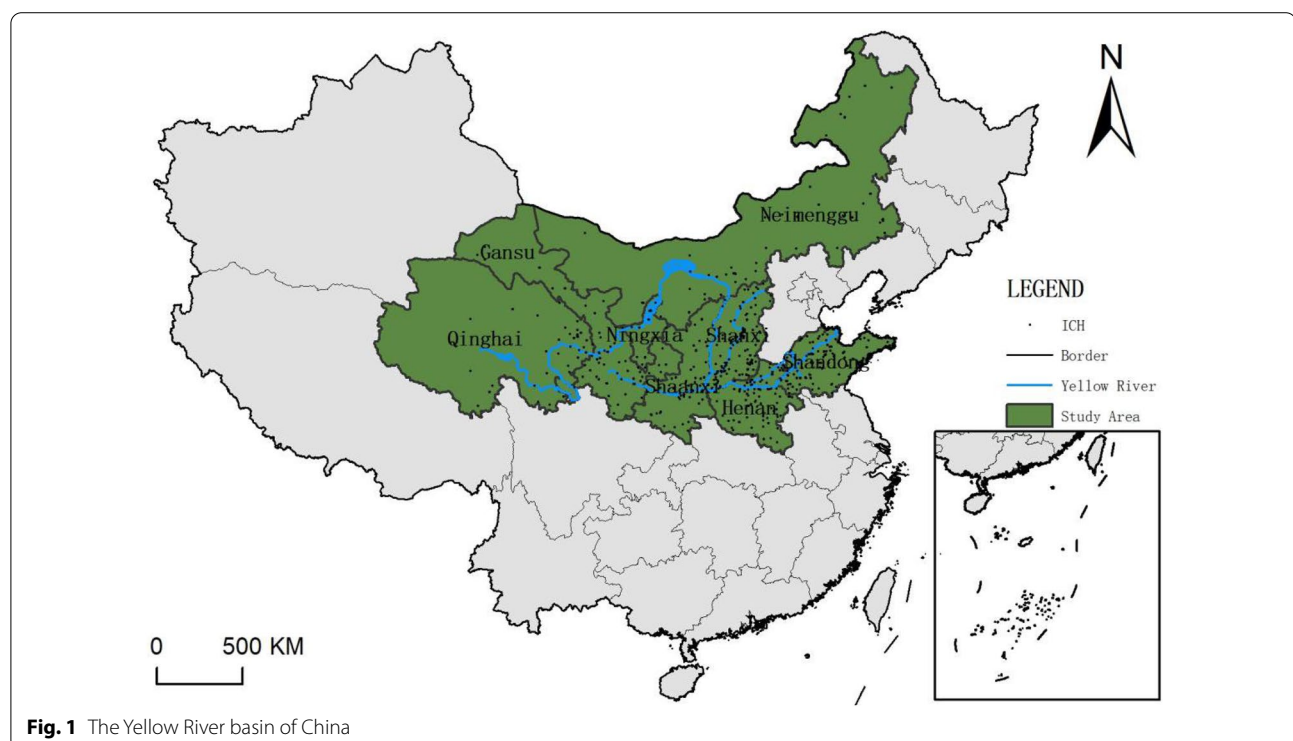

Fig. 1 The Yellow River basin of China

Nie *et al. Heritage Science* (2022) 10:121

Page 4 of 16

Table 1 List of intangible cultural Heritage data in the Yellow River Basin

	Province	Traditional theatre	Traditional skills	Traditional music	Folklore	Traditional fine arts	Folk literature	Traditional dance	Quyi	Traditional sports, entertainment and acrobatics	Traditional medicine	Total	Percent
West	Qinghai	3	11	15	16	11	9	9	4	3	7	88	9.90
	Gansu	11	12	12	12	8	7	11	7	1	2	83	9.34
	Ningxia	1	7	3	4	5	1	1	1	0	5	28	3.15
	Shaanxi	18	12	15	9	12	7	6	8	2	2	91	10.24
	Total	33	42	45	41	36	24	27	20	6	16	290	32.62
Middle	Neimenggu	5	15	23	19	9	8	5	6	9	7	106	11.92
	Shanxi	38	35	18	23	19	10	14	11	6	8	182	20.47
	Henan	29	14	13	14	14	10	10	5	10	6	125	14.06
	Total	72	64	54	56	42	28	29	22	25	21	413	46.46
East	Shandong	33	19	18	14	28	27	13	13	15	6	186	20.92
	Total	33	19	18	14	28	27	13	13	15	6	186	20.92
	Total	138	125	117	111	106	79	69	55	46	43	889	100
	Percent	15.52	14.06	13.16	12.49	11.92	8.89	7.76	6.19	5.17	4.84	100	

Nie *et al. Heritage Science* (2022) 10:121

Page 5 of 16

the total number of ICH sites; d_i represents the straight-line distance between the nearest ICH sites; and A represents the area of the study area. Taking the value of *ANN* as the evaluation standard, this paper finds that when *the ANN* value is greater than 1, the spatial distribution of ICH sites tends to be even, and the larger the value is, the higher the degree of even distribution.When the *ANN* value is 1, it tends to be random.When the *ANN* value is less than 1, it tends to be concentrated, and the smaller the value is, the higher the degree of agglomeration.

Kernel density

This paper takes the location of ICH protection units as ICH sites. By calculating kernel density, the areas gathering ICH can be visually displayed on a map, and the degree of ICH agglomeration can be evaluated. In addition, kernel density can represent the probability of the occurrence of ICH in this region. The denser the intangible cultural heritage is, the higher the probability of the occurrence of ICH [21].The formula is:

$$f(x) = \frac{1}{nh} \sum_{i=1}^{n} k\left(\frac{x - X_i}{h}\right)$$

In the formula, *k(...)*is the kernel function, *h > 0* is the bandwidth, and $(x - X_i)$ is the distance from estimated point *x* to ICH point X_i.

Geodetector

Spatial differentiation is one of the basic characteristics of geographical phenomena, and Geodetector is a tool for detecting and exploiting it. Geodetector includes four detectors, and this paper uses two of them: the factor detector and the interaction detector. The formula is:

$$q = 1 - \frac{\sum_{h=1}^{L} N_h \sigma_h^2}{N \sigma^2}$$

In this formula, *h = 1, ...,L* is the stratification of variable *Y* or factor *X*, that is, the classification or partition. N_h and *N*are the numbers of units in layer *h* and the whole area, respectively. σ_h^2 and σ^2 are the variances in the *Y* value in layer *h* and the whole area, respectively. The range of *Y* is from 0 to 1. The larger the value of *q* is, the stronger the explanatory power of independent variable *X* with regard to dependent variable *Y*, and vice versa [22–24].

Spatial distribution characteristics of ICH in the Yellow River basin of China

Distribution structure of ICH in the Yellow River basin of China

As Table 1 shows, the Yellow River basin can be divided into the western, central, and eastern regions based on the division criteria for geographical areas. The western region, including Qinghai, Gansu, Ningxia, and Shaanxi, has 290 ICH sites, accounting for 32.64% of the total. The central region, including Inner Mongolia, Shanxi, and Henan, has 186 ICH sites, accounting for 46.46%. The eastern region, including only Shandong, has 186 ICH sites, accounting for 20.92%. Most of the ICH in the Yellow River basin is concentrated in the central region, showing a stark contrast to the Yangtze River basin, where ICH is concentrated in the east. The amount of national ICH in the Yellow River basin varies greatly in different areas [25]. The number of national ICH sites in the central region (413) is close to the sum of sites in the eastern(186) and western(290) regions. The number also varies widely from province to province. Shandong Province has the largest number of ICH sites, 186, and Ningxia Province has the fewest ICH sites, with only 28 (Table 1).

Figure 1 shows the Lorenz curve of ICH in the Yellow River basin, and the value of the concentration index I is 0.2338. Based on the degree of convexity and the size of the concentration index, the distribution of the ten types of ICH in the Yellow River basin is uneven. The types of ICH are mostly traditional theatre (138 sites) and traditional skills (125 sites), accounting for 15.52% and 14.06% of the total amount, respectively.Traditional music (117 sites), folklore (111 sites), and traditional fine arts (106 sites) are the second largest, accounting for 37.57%. Folk literature (79 sites), traditional dance (69 sites) and Quyi (55 sites) are all less than 100, accounting for 22.83.Traditional sports, entertainment and acrobatics (46 sites) and traditional medicine (43 sites) are the lowest, accounting for 10.01%.

Differences in the spatial distribution of ICH in the Yellow River basin of China

There are differences in the number and types of ICH in the Yellow River basin among the eight provinces.

Taking 50 ICH sites as an example, this paper divides the eight provinces into four levels in terms of the number of ICH sites. The first level is Shandong (186 sites) and Shanxi (182 sites), whose numbers are all over 150 and 180.The second level is Inner Mongolia (106 sites) and Henan (125 sites), with numbers between 100 and 150.The third level is Qinghai (88 sites), Gansu (83 sites) and Shaanxi (91 sites), with numbers between 50 and 100. The last level is Ningxia, with fewer than 50 sites.

In regard to the types of ICH, Shanxi has the largest number of traditional theatres (38 sites), followed by Shandong (33 sites), Henan (29 sites), and other provinces. Among these provinces, Ningxia has the least, with only 1site. The province with the largest number of traditional skills sites is Shanxi, with 35sites, and only Shanxi

Nie *et al. Heritage Science* (2022) 10:121

Page 6 of 16

Table 2 Average nearest neighbor index of national intangible cultural heritage

Types	Traditional theatre	Traditional skills	Traditional music	Folklore	Traditional fine arts	Folk literature	Traditional dance	Quyi	Traditional sports, entertainment and acrobatics	Traditional medicine	Total
Amount	138	125	117	111	106	79	69	55	46	43	889
ANN	0.62	0.49	0.65	0.61	0.73	0.72	0.65	0.62	0.83	0.54	0.29
z	− 8.52	− 10.82	− 7.33	− 7.7	− 5.38	− 4.7	− 5.61	− 5.39	− 2.2	− 5.79	− 40.25
p	0	0	0	0	0	0	0	0	0.03	0	0

Nie *et al. Heritage Science* (2022) 10:121

Page 7 of 16

has over 30 sites. The number of traditional skills sites varies slightly in other provinces, between 10 and 20. The distribution of traditional music and folkloresites is relatively even. There is not much difference in the number between provinces, except that Ningxia has a small number. Shandong has the largest number of traditional fine artssites (28), and Ningxia has the lowest number (5). The province with the largest number of folk literature sites is also Shandong (27 sites), and the number in other provinces is far lower than that in Shandong, with fewer than 10sites. Shanxi and Shandong have many traditional dance sites, with 14 and 13, respectively, and Ningxia has the fewest (1 site). There are 13 Quyi sites and 15 traditional sports, entertainment, and acrobatics sites in Shandong, ranking first among all types of ICH. The number of traditional medicine sites is no more than 10, among which Shanxi has the largest number (8 sites) and Shaanxi (2 sites) and Gansu(2 sites) have the smallest.

Spatial distribution of types of ICH in the Yellow River basin of China

This paper uses the built-in average nearest neighbor tool of ArcGIS 10.2 software to process the ICH site data and obtains the nearest neighbor index through calculation (Table 2).

The calculation results indicate that the nearest neighbor ratio (*ANN* value) of all ICH sites in the Yellow River basin is 0.29 with a confidence degree of 99%, showing an absolute aggregated distribution feature. Based on the value of *ANN*, all ICH types present the characteristic of an overall aggregated distribution, but the degree is different. Specifically, traditional skills sitesrank first (0.49), and traditional medicine sitesrank second (0.54). Folklore (0.61), traditional theatre (0.62), Quyi (0.62), traditional dance (0.65), traditional music(0.65), folk literature (0.72), and traditional fine arts (0.73) sites have lower levels of agglomeration, and traditional sports, entertainment, and acrobatics sites have the lowest levels (0.83).

Density distribution characteristics of ICH in the Yellow River basin of China

Overall distribution characteristics

Using the built-in kernel density analysis tool of ArcGIS 10.2 software, the paper maps the overall kernel density of ICH in the Yellow River basin (Fig. 2). As shown in Fig. 2, ICH is gathered around the Yellow River basin. Overall, from east to west, the ICH density presents a triangular "one area and three points" pattern. The "one area" refers to the high-density core area of ICH composed of western Shandong, northern Henan, and southern Shanxi. The "three points" refer to, from east to west, Hohhot in Inner Mongolia, Yinchuan in Ningxia, and Haidong in Qinghai. Taking the high-density core area as

one triangular point, the paper draws a line to the west to Xining along the Wei River and to the northwest to Hohhot along the middle and lower reaches of the Yellow River. The line connecting Xining, Yinchuan, and Hohhot is the third side of this triangle. Figure 2 shows that most ICH is concentrated in the "triangle" area.

Distribution characteristics of various types of ICH

Figure 3 presents the kernel density distribution of various types of ICH. Traditional theatresites are distributed in sections in northern Henan, western Shandong, southeastern Shaanxi, and southern Shanxi, mainly in Heze in Shandong and Puyang in Henan. Traditional skills and folk loresites have a similar distribution, mainly gathering in sections around the triangle area composed of southern Shanxi, southern Shanxi, and northwestern Henan, and among these areas, Taiyuan in Shanxi is the city with the highest density. These ICH sites are also concentrated in spots in central Shandong and eastern Qingdao. Traditional music and traditional fine arts sites have a similar distribution. They are distributed evenly in the middle and lower reaches of the Yellow River, mainly in sections in Shanxi, Shaanxi, Henan and western Shandong. The ICH density on the boundary between Henan and Shandong is the highest. Remarkably, Xining and Haidong, located in eastern Qinghai, are also high-density gathering areas of these types of ICH because the two cities are home to many ethnic groups that have a culture rich in songs, dance, and art.Folk literature sites are mainly distributed in strips on the border of Shandong, Shanxi, and Henan along the lower reaches of the Yellow River; traditional dance and Quyi sites share similar agglomeration areas, mainly distributed in sections at the boundary of the middle and lower reaches of the Yellow River. In the upper reaches, the region where Qinghai borders Gansu is the sub density agglomeration area. Traditional sports, entertainment, and acrobatics sites are distributed in strips in Shanxi, Henan, and Shandong along the middle and lower reaches of the Yellow River.Traditional medicine sites,which have a small number, are mainly distributed in spots in the capitals of provinces, mostly Xining in Qinghai, Yinchuan in Ningxia, Hohhotin Inner Mongolia, Taiyuan in Shanxi, and Jinan in Shandong. In terms of distribution, all types of ICH are mainly concentrated in the economically developed central and eastern regions. Although eastern Qinghai, an ethnic minority settlement, lacks a high level of economic competitiveness, it is the agglomeration area where traditional music, folklore, traditional fine arts, folk literature, traditional dance, Quyi, and traditional medicine sites gather. The rich and diverse cultures of ethnic minorities have played an important role in the inheritance and promotion of ICH.
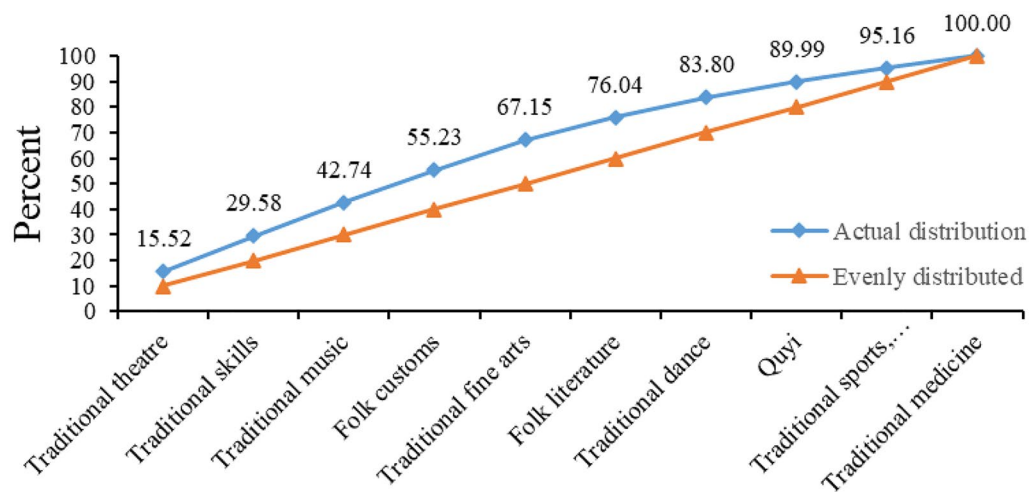
Nie *et al. Heritage Science* (2022) 10:121

Page 8 of 16

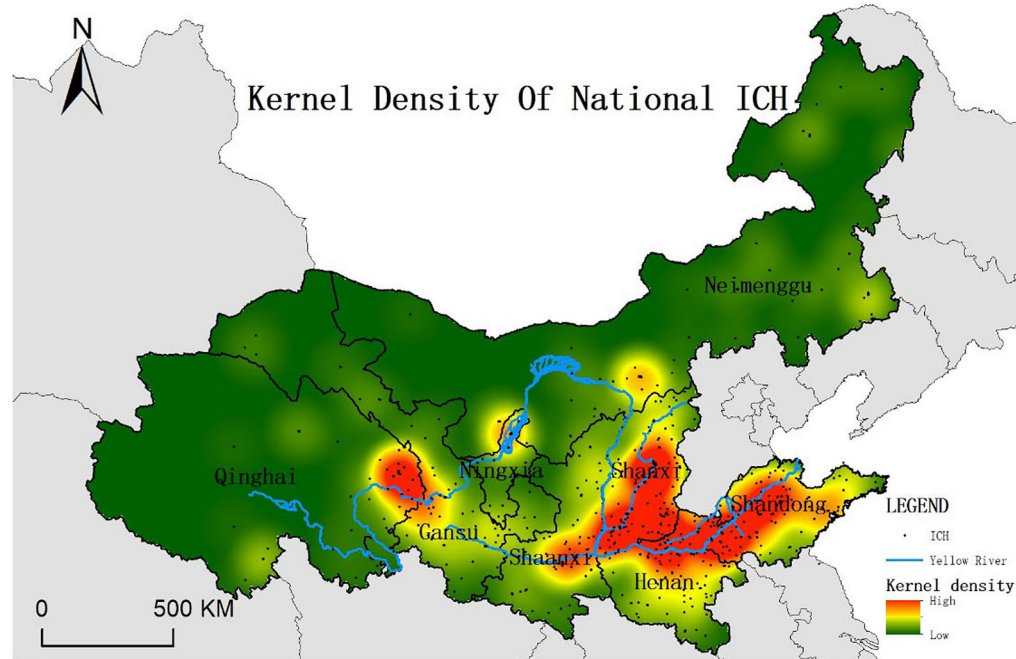**Fig. 2** Lorenz curve of ICH types in the Yellow River basin of China

Fig. 3 Overall kernel density distribution map of ICH in the Yellow River basin of China

Results and discussion: factors affecting the spatial distribution of ICH in the Yellow River basin of China

The origin, development, and preservation of ICH are closely related to geographical environmental factors and social and humanistic factors. Rivers, topography, total population, the urbanization level, the regional economic development level, and transportation all have an important impact on regional ICH. We analyze the main factors affecting the distribution of ICH in the Yellow River basin by compiling and carefully studying the spatial distribution of ICH and the influencing factors in China [26, 27] and combining the actual situation in the Yellow River basin with expert references. The geographical environmental factors mainly include 2 factors, namely, topography and water density, which are obtained from the Geospatial Data Cloud website [28].The social and humanistic factors mainly include 7 factors, namely,

Nie *et al. Heritage Science* (2022) 10:121

Page 9 of 16

Table 3 Influencing factors and their determinant values

Dimensions	Evaluation Indicators	q										
		ICH	Traditional theatre	Traditional skills	Traditional music	Folklore	Traditional fine arts	Folk literature	Traditional dance	Quyi	Traditional sports, entertainment and acrobatics	Traditional medicine
Geographical environment	Topography	0.1	0.09	0.02	0.04	0.03	0.06	0.07	0.03	0.03	0.05	0.02
	River density	0.17	0.12	0.06	0.06	0.08	0.11	0.08	0.07	0.06	0.04	0.03
Social humanities	GDP	0.39	0.37	0.26	0.21	0.23	0.27	0.29	0.24	0.26	0.26	0.23
	Population density	0.39	0.36	0.25	0.2	0.23	0.26	0.29	0.24	0.25	0.25	0.2
	Minority population proportion	0.38	0.35	0.25	0.2	0.22	0.25	0.25	0.23	0.25	0.25	0.23
	Railway density	0.37	0.26	0.2	0.12	0.15	0.15	0.12	0.04	0.13	0.09	0.15
	Highway density	0.41	0.29	0.28	0.16	0.16	0.23	0.15	0.08	0.11	0.13	0.11
	Amount of cultural groups	0.3	0.26	0.17	0.15	0.17	0.18	0.2	0.14	0.15	0.15	0.11
	Urbanization level	0.39	0.37	0.26	0.21	0.23	0.27	0.29	0.24	0.26	0.26	0.23

Nie *et al. Heritage Science* (2022) 10:121

Page 10 of 16

GDP, population density, the minority population ratio, railroad density, highway density, the number of cultural groups and the urbanization level, and the data are collected from municipal administrative units in the Yellow River basin. The number of cultural groups refers to the sum of the number of museums, cultural centers, and performing arts groups in the region, which represents the importance of culture and arts in the region. Among the social and humanistic factors above, the statistics on GDP, population density, the percentage of the minority population, the number of cultural groups, and the urbanization level are obtained from the Yellow River basin Municipalities 2021 Statistical Yearbook [29], and the statistics on railroad density and road density are obtained from the Geospatial Data Cloud website.

Based on research on the actual situation of the Yellow River basin and the influencing factors on the spatial distribution of ICH, this paper calculates and analyzes nine specific factors (see Table 3) based on the dimensions of the geographical environment and society and culture that affect the spatial distribution of ICH in the Yellow River basin by using Geodetector.

The q value of all influencing factors shown in Table 3 is calculated by Geodetector. Among the social factors, highway density (0.41) is the strongest indicator that affects the ICH in the Yellow River basin, which means that highways, as a flexible and convenient mode of transportation, are important in ICH formation and preservation. In addition, total GDP (0.39) represents the level of regional economic development, population density (0.39) represents the population per unit land area, and the urbanization level (0.39) represents the degree of urbanization in a region, which are the indicators that reflect the development of the regional economy. The three indicators tie for second among all influencing factors. This result shows that after meeting material needs, human beings start to focus on spiritual needs. ICH, as a kind of intangible culture, not only contains the history and culture of different periods but also includes a strong sense of belonging to the nation. It is an important channel for building cultural self-confidence. In addition, the number of cultural groups (0.30) is the weakest indicator, which means that the cultural group factor has a minor impact on the distribution of ICH in the Yellow River basin. Although cultural groups play an important role in social and public cultural services, their imperfect management system, different standards, and lack of professional team members all make it difficult for them to have a crucial influence like other factors do.

Geographical environmental factors

The geographical environment is an important prerequisite for human existence and cultural creation. It has deep ties to the formation of regional ICH. In terms of topography, the Yellow River basin consists of, from west to east, the Qinghai-Tibet Plateau, the Inner Mongolia Plateau, the Loess Plateau, and the Huang-Hai Plain. There are four kinds of landscapes and three ladders, resulting in a topography that is high in the west and low in the east. The enormous differences in topography and landscape make the Yellow River basin an area where many ethnic groups have different cultural styles. The plateau area is so vast that there are many lakes and rivers and large areas of grassland; thus, nomadic culture emerged. Nomadic culture is characterized by movement. It has a unique national style in dance, painting, music, etc.ICH also shows strong characteristics of nationality, such as Tibetan folk songs in Qinghai, Andai dance in Inner Mongolia, and Jiangzhou drum music in Shanxi. The plain area has open ground, smooth landscapes, and low altitude, leading to frequent cultural exchanges. Under this circumstance, agrarian culture formed. This kind of peaceful and self-sufficient culture makes its ICH elegant and exquisite, such as the shadow play in Shandong and Yu Opera in Henan. Different topographies shape different lifestyles, and different lifestyles create different cultures, which in turn affect ICH. However, topography fails to determine the formation of ICH. As shown in Table 3, topography (0.1) has a certain impact on the spatial distribution of ICH, but the impact is not deep. In terms of rivers, the survival and prosperity of human beings have been closely connected with rivers since antiquity, and early humans developed the custom of "living along the river". Therefore, the river system plays an important role in the distribution of ICH. Based on the calculation of Geodetector, the influence degree of the river system is 0.17, indicating that compared with topography, the river system has a greater influence on ICH, but the influence is also limited.
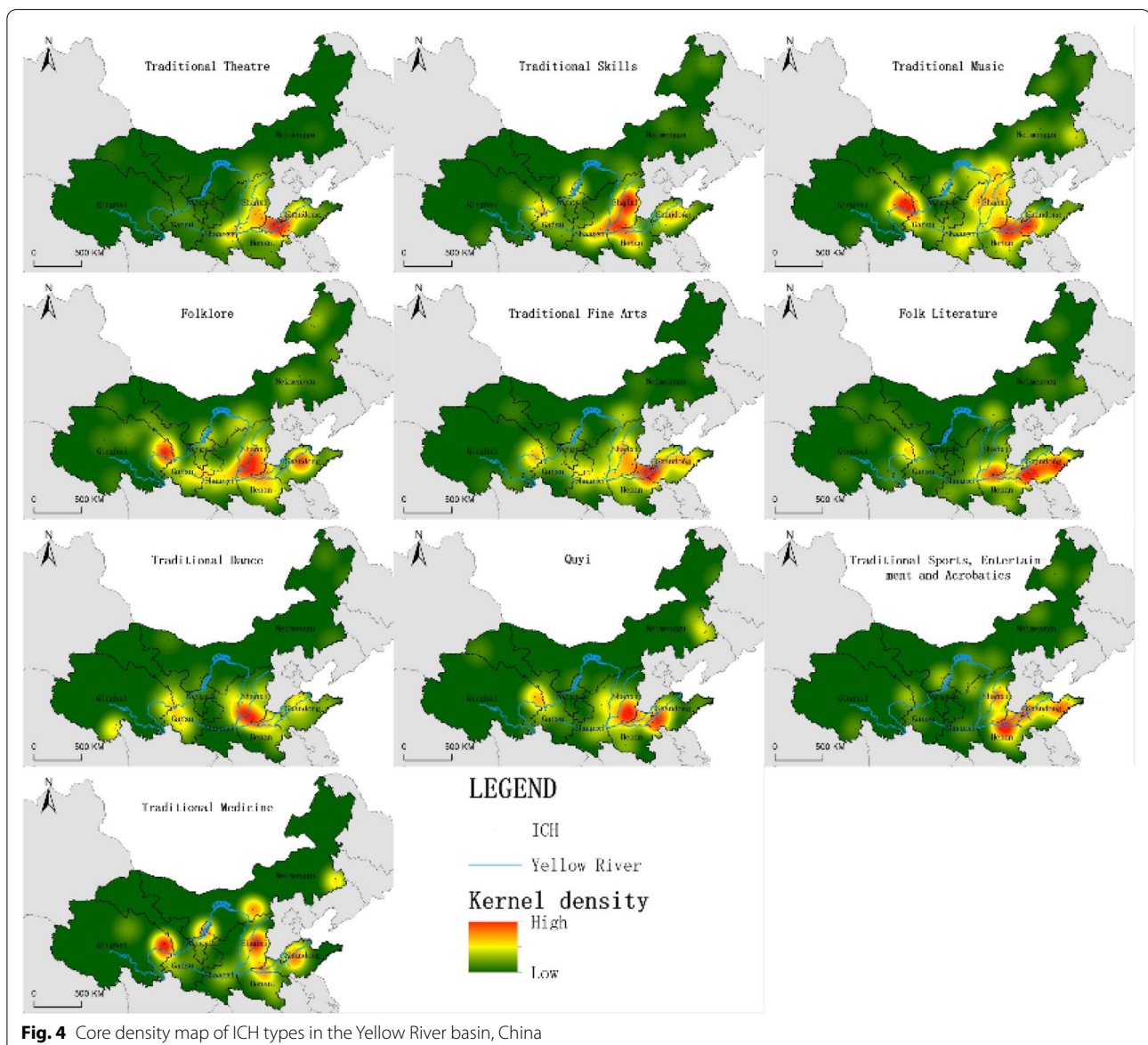
Social and humanistic factors

ICH is a product of human intelligence and labor, and its spatial distribution has a close connection with social and humanistic factors. Based on the analysis of the results from Geodetector, this paper conducts complete research to study the influence of relevant factors on ICH.

As shown in Table 3, the social factors influencing the distribution of ICH in the Yellow River basin are in descending order as follows: highway density (0.47), GDP (0.39), population density (0.39), the urbanization level (0.39), the proportion of the minority population (0.38), railway density (0.37) and the number of cultural groups (0.30). (Here, cultural groups refer to regional museums, cultural centers, and performing arts groups.) Among these factors, highway density has the greatest impact. Cultural communication and exchanges are very active

Nie *et al. Heritage Science* (2022) 10:121

Page 11 of 16

in a dense highway area, which is favorable for the protection and inheritance of ICH. Figure 4 indicates that Shandong Province has the highest density of highways among the nine provinces in the Yellow River basin, and in return, it supports the greatest ICH agglomeration. GDP, population density, and the urbanization level have a great impact on the distribution of ICH. GDP is an important indicator for measuring the development of the regional economy, and ICH tends to concentrate in areas with advanced economic performance. As the creator of ICH culture, human beings have a deep impact on its formation and spatial distribution. A wide variety of ICH is more likely to form in densely populated areas. The urbanization level, an important indicator of the

process and degree of population agglomeration in cities, can reflect the life concepts and cultural quality of area residents. ICH protection is of great significance due to rapid urbanization. The proportion of the minority population also affects the spatial distribution of ICH to some extent. Since antiquity, there have been many ethnic minorities living in the Yellow River basin, and its plateau terrain and closed topography protect minority cultures from foreign cultural invasion. These different minority cultures make ICH unique (Fig. 5).

The impact of railways is 0.37, which is lower than that of highways because it is difficult to build railways in such difficult terrain stretching across three steps. Compared with highways, the mileageis also much
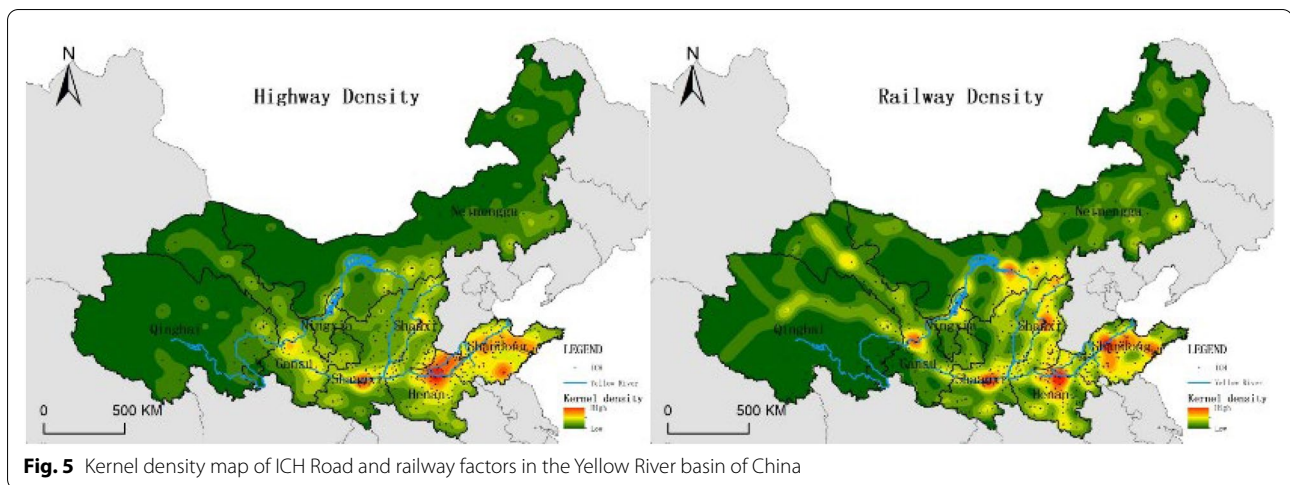

Fig. 4 Core density map of ICH types in the Yellow River basin, China

Nie *et al. Heritage Science* (2022) 10:121

Page 12 of 16

Fig. 5 Kernel density map of ICH Road and railway factors in the Yellow River basin of China

shorter. Therefore, the influence of railways is limited. Cultural groups have the least influence on the spatial distribution of ICH. The reason is that cultural groups have encountered many difficulties in the development of the market economy.

Notably, different social factors have different influences on the spatial distribution of ICH. Table 4 shows the q value of each type of ICH in descending order. Among all factors, GDP and the urbanization level have the greatest impact. Traditional medicine sites are affected mostly by the proportion of the minority population proportion, while the other nine types are more influenced by population density. For this reason, the concentration of traditional medicine sites in eastern Qinghai, where ethnic minorities gather, is significantly greater than that in the central and eastern regions. The order of influencing factors starts to be different from the fifth factor, and among them, traditional theatre, traditional music, and traditional fine arts sites are greatly affected by highway density, while traditional skills and traditional medicine sites are greatly affected by railway density, which is one of the reasons why Shanxi,which has a low density of highways, can become a gathering area for two kinds of ICH. In addition, the number of cultural groups (the sum of museums, cultural centers, and performing arts troupes) has a close connection with folklore, folk literature, traditional dance, Quyi, traditional sports, entertainment, and acrobatics sites, indicating that folklore and folk literature sites require venues such as museums and cultural centers and traditional dance, Quyi and traditional sports, entertainment and acrobatics sites require more performing arts troupes to perform and inherit.

Summary of the spatial distribution of ICH in the Yellow River basin and discussion of its protection and development
Summary of the spatial distribution of ICH in the Yellow River basin
By analyzing the spatial structures and influencing factors of 889 national ICH sites in the Yellow River basin of China, this paper draws the following conclusions.

First, there are clear provincial differences in the national ICH in the Yellow River basin, and there are differences in the eastern, central, and western regions. The ICH amount in the central region is much larger than that in the eastern and western regions. Meanwhile, the numeral structure of ICH types is uneven. There are many traditional theatres, traditional skills, and traditional music sites, while the number of traditional sports, entertainment and acrobatics, and traditional medicine sites is relatively small.

Second, ICH sites are characterized by an aggregated distribution, and most of them gather in the Yellow River basin. From east to west, the ICH density presents a triangular "one area and three points" pattern. Traditional skills, traditional medicine, traditional theatre, traditional music, and folklore sites are more concentrated. The agglomeration degree of traditional dance, traditional music, folk literature, and traditional fine arts sites is weaker, and the agglomeration degree of traditional sports, entertainment, and acrobatics sites is the weakest.

Third, the gathering areas of ICH in the Yellow River basin are different, and most ICH sites are concentrated in the central and eastern areas with a developed economy. Specifically, traditional theatre sites are distributed in sections in northern Henan, western Shandong, southeastern Shaanxi and southern Shanxi.Traditional skills

Nie *et al. Heritage Science* (2022) 10:121

Page 13 of 16

Table 4 Descending order table of influence of social and cultural factors on spatial distribution of various ICH

	Traditional theatre	Traditional skills	Traditional music	Folklore	Traditional fine arts	Folk literature	Traditional dance	Quyi	Traditional sports, entertainment and acrobatics	Traditional medicine
1	GDP	GDP	GDP	GDP	GDP	GDP	GDP	GDP	GDP	GDP
2	Urbanization level	Urbanization level	Urbanization level	Urbanization level	Urbanization level	Urbanization level	Urbanization level	Urbanization level	Urbanization level	Urbanization level
3	Population density	Population density	Population density	Population density	Population density	Population density	Population density	Population density	Population density	Minority population proportion
4	Minority population proportion	Minority population proportion	Minority population proportion	Minority population proportion	Minority population proportion	Minority population proportion	Minority population proportion	Minority population proportion	Minority population proportion	Population density
5	Highway density	Railway density	Highway density	Amount of cultural groups	Highway density	Amount of cultural groups	Amount of cultural groups	Amount of cultural groups	Amount of cultural groups	Railway density
6	Railway density	Highway density	Amount of cultural groups	Highway density	Amount of cultural groups	Highway density	Highway density	Railway density	Highway density	Amount of cultural groups
7	Amount of cultural groups	Amount of cultural groups	Railway density	Railway density	Railway density	Railway density	Railway density	Highway density	Railway density	Highway density

Nie *et al. Heritage Science* (2022) 10:121

Page 14 of 16

sites are mainly distributed in sections in the triangle area composed of southern Shanxi, southern Shaanxi and northwestern Henan.Traditional music and traditional fine arts sites are distributed evenly in the middle and lower reaches of the Yellow River, mainly in sections in Shanxi, Shaanxi, Henan and western Shandong. folk literature sites are mainly distributed in strips on the border of Shandong, Shanxi and Henan.Traditional dance and Quyi sites are distributed in sections at the boundary of the middle and lower reaches of the Yellow River. traditional sports, entertainment and acrobatics sites are distributed in strips in Shanxi, Henan and Shandong along the middle and lower reaches of the Yellow River.Traditional medicine sites, which have a small number, are mainly distributed in spots in Xining in Qinghai, Yingchuan in Ningxia, Hohhot in Inner Mongolia, Taiyuan in Shanxi and Jinan in Shandong.

Fourth, the influence of the spatial distribution of ICH in the Yellow River basin is reflected in many factors. In terms of geographical factors, topography and the river system have a certain impact on the spatial distribution of ICH, but the impact is not deep, while social and humanistic factors have a larger effect on the spatial distribution of ICH. Among these factors, highway density has the greatest impact, and GDP, population density, and the urbanization level also exert an evident influence on the distribution.

Methods of ICH protection and development in the Yellow River basin

Improve the construction of transport infrastructure in the Yellow River basin

The construction of transport infrastructure is a leading industry for the development of the national economy, and it is also a basic industry for ICH development. This paper has proven the positive effect of transport on ICH development. The national "Development Plan for a Modern Comprehensive Transportation System in the 14th Five-year Plan" was recently approved by experts, and provinces in the Yellow River basin, such as Qinghai, Gansu, Shaanxi, Henan, and Shandong, have also unveiled plans for major targets for transportation network development in the 14th Five-Year Plan period. Therefore, the construction of transport infrastructure can promote the development and extension of ICH. On the one hand, more efforts should be made to accelerate the construction of the "ten-vertical and ten-horizontal" channels in the Yellow River basin to support the establishment of metropolitan areas of ICH and unlock its potential for development. On the other hand, the ability of transportation to expand ICH needs to be improved based on the practical requirements of the regional economy and development. For example, the operation of transport infrastructure in the Yellow River basin can be connected efficiently and intelligently with publicization of ICH culture with"Internet Plus" help.

Develop the culture and tourism industry in the Yellow River basin

Currently, in China, the increased demand for cultural consumption makes tourism an important market and the main form of cultural consumption. The culturalization of the economy and the economicalization of culture are often considered to be characteristics of post modernity [30]. The economy and culture are closely linked in modern society, and in regard to economic consumption, consumers pay attention not only to use value but also to cultural background. Therefore,integrating culture and tourism is an important key to releasing the economic and cultural value of ICH. Considering that the ICH in the Yellow River basin has obvious regional characteristics, the manufacture of cultural tourism products with local features based on ICH culture is not only the main form of livelihood transformation and cultural inheritance but also an important way to achieve regional economic development through cultural feelings.

To incorporate ICH into the cultural tourism industry, the development goals of telling the story of ICH in the Yellow River basin, connecting ICH cities, and taking advantage of the ICH gifts given by the Yellow River can be set. This involves two important parts. The first is the development of ICH tourist routes. The focus should be placed on ICH resources in the Yellow River basin because the combination of its human landscape and natural landscape provides tourists with an immersive experience, which can strengthen their national pride and make national culture engage in the tourism industry. The second is the design and brand of cultural and creative ICH products. As a creation of the deep integration of culture, the economy, and creativity, cultural and creative products contain representative cultural codes of ICH in the Yellow River basin. The government needs to carry out research to determine the targeted consumers and their demands in terms of cultural attributes and modern product markets and to clarify the brand and positioning, meeting the needs of different consumers for by-products with different costs, prices, and levels of circulation. In addition, a sales network supported by various social media platforms with multiple channels and levels facilitates the formation of an industrial chain of ICH cultural and creative products in the Yellow River basin.

Specifically, we should actively try to build Yellow River urban ICH cultural tourism villages with the ICH resources in the Yellow River basin as the core, combined with its cultural, historical, and natural landscape. By

Nie *et al. Heritage Science* (2022) 10:121

Page 15 of 16

carrying out some folk culture festival activities, the ICH of traditional opera, music, and dance, such as Huang shadow play in Qinghai Province, Ziyang folk song in Shaanxi Province and the lurigele dance of the Daur nationality in Inner Mongolia, can be developed into immersive tourism activities so that tourists can personally participate in and experience the charm of the ICH of the Yellow River basin [31]. Folk literature and ICH, such as the legend of the Yang family in Shanxi Province and the Nuwa memorial ceremony in Gansu Province, can be compiled into sitcoms and displayed to tourists on the spot. At the same time, internet tools, combined with short videos, films, and television dramas, can be used to realize the dual channels of offline and online ICH dissemination. Traditional techniques and art ICH, such as the Tangxi sword forging skills in Henan Province and Gaomi ash throwing new year pictures in Shandong Province, can be displayed to visitors through an ICH museum or developed into cultural and creative products to deeply integrate their culture, economy, and creativity to increase the added value of Yellow River culture.

Completely promote the establishment of an ICH industrial platform for the Yellow River basin in China

Malinowski believes that material tools and social ideas can survive and spread only when they meet the biological and social needs of human beings, and if they lose this function, they will disappear from history. The emergence of ICH is the result of the satisfaction of the material or spiritual needs of social groups. To achieve the goal of ICH protection and development, efforts should be made to ensure that ICH adapts to today's social environment to meet the material or spiritual needs of people, which coincides with the opinions of many scholars on "productive protection" and "living inheritance". Therefore, it is important for ICH in the Yellow River basin to identify the needs of modern society, develop new economic formats from the dimension of industrialization and utilize them properly. Only in this way can ICH in the Yellow River basin achieve creative protection and development.

The industrial development of ICH in the Yellow River basin can focus on the culture of the Yellow River and take advantage of integrated resources to create characteristic brands. Characteristic brands formed by the combination of similar ICH sites also have scale effects on the economy and cultural communication and transmission. As indicate above, this paper shows that there are many ICH sites in the Yellow River basin, but the distribution is scattered. Using the internet to build an industrial platform can overcome the regional limitations of ICH integration and unify financing, exhibitions, transactions, and other parts of the ICH industrial chain to

maximize the economic and social benefits of industrial development.

Conclusion

As an important part of national cultural protection, ICH is a major force for regional economic development. Research on ICH cannot end with the analysis of the spatial distribution of ICH in the Yellow River basin of China, and it is necessary to further study the influencing factors based on its distribution characteristics, which is a significant step for ICH research and a key part of ICH protection. According to the theory of cultural ecology, Rodolphe Stavenha proposes that social culture and natural ecology interact with each other, and only by inheriting and developing in a specific cultural ecosystem and focusing on its cultural ecology can ICH evolve and continuously adapt to the changing social environment.

Based on the findings of this research, this paper makes suggestions on the spatial layout and protection and development of the ICH in the Yellow River basin of China from the perspective of sustainable development.

First, the western, central, and eastern regions of China's Yellow River basin have different numbers, types, living conditions, and development statuses of ICH. The western region stands out due to its ethnic culture, but it has a poor economy, and its transportation is relatively inconvenient. Therefore, more funding should be put into ICH sites to boost efficiency in the use of ICH tourism, obtain economic benefits, ensure the management and protection of ICH and create a virtuous circle of ICH itself. Considering that municipalities and provinces in the central and eastern regions have relatively developed economies and high levels of urbanization, more efforts should be put into ICH marketing to realize its cultural value and promote regional economic growth. It is also necessary to circumvent the negative effects of over commercialization on the authenticity of ICH.

Second, due to the obvious cultural differences in the Yellow River basin of China, regional cultural characteristics should be highlighted in ICH development. Efforts need to be made to enhance exchanges and cooperation to gradually achieve interactive development from the point to the area. It is also necessary to strengthen the systematic protection of the ICH in the Yellow River basin, drive coordinated development and enhance transmission and promotion.

Third, ICH is inherited and developed, and tourism is an important method of its "living transmission". Developing cultural and creative products, pursuing the path of integrated cultural and tourism development, and using tourism to drive ICH inheritance and protection are future development directions. The natural geographical environment is the carrier of ICH culture. In improving

Nie *et al. Heritage Science* (2022) 10:121

Page 16 of 16

transportation and planning landscape construction to realize the use of tourism, more attention should be paid to protecting the ICH natural ecological system.

Author contributions
LZ briefly introduced the background and reviewed all the published papers. YX and XX collated and collected relevant data and made tables for explanation. XN summarized the factors affecting the spatial distribution ofintangible cultural heritage in the Yellow River basin of China andproposed suggestions for the protection and development of intangible cultural heritage in China's Yellow River basin. All authors read and approved the final manuscript.

Availability of data and materials
The datasets used and analyzed during the current study are available from the author upon reasonable request.

Declarations

Competing interests
The authors declare that they have no competing interests.

References
1. Bille M. Assembling heritage: investigating the Unesco proclamation of Bedouin intangible heritage in Jordan. Int J Herit Stud. 2012;18(2):107–123.
2. Giudici E, Melis C, Dessì S. Is intangible cultural heritage able to promotesustainability in tourism? Int J Qual Serv Sci. 2013;5(1):101–114.
3. Cominelli F, Greffe X. Intangible cultural heritage: safeguarding for creativity. City Cult Soc. 2012;3(4):245–250.
4. Wang Y, Bramwell B. Heritage protection and tourism development priorities in Hangzhou, China: a political economy and governance perspective. Tour Manage. 2012;33(1):988–998.
5. Cozzani G, Pozzi F, Dagnino FM, Katos AV, Katsouli EF. Innovative technologies for intangible cultural heritage education and preservation: the case of i-Treasures. Pers Ubiquit Comput. 2017;21(2):253–265.
6. Arizpe L. How to reconceptualize intangible cultural heritage. Culture, diversity and heritage: major studies. Springer International Publishing; 2015. p. 95–99.
7. Arizpe L. Intangible cultural heritage, diversity and coherence. Museum Int. 2004;56(1):130–136.
8. Robinson RNS, Clifford C. Authenticity and festival food service experience. Ann Tour Res. 2012;39(2):571–600.
9. Smith L, Morgan A, Meer AVD. Community-driven research in cultural heritage management: the Waanyi Women's History Project. Int J Herit Stud. 2010;9(1):65–80.
10. Saleh F, Ryan C. Jazz and knitwear: factors that attracts to festivals. Tour Manage. 1993;14(4):289–297.
11. Fromm AB. Ethnographic museums and intangible cultural heritage return to our roots. J Mar Island Cult. 2016;5(2):89–94.
12. Cheng Q, Ling SP. Geographical distribution and affecting factors of the intangible cultural heritage in China. Scientia Geographica Sinica. 2013;33(10):1166–1172 (**in Chinese**).
13. Zhang XY, Yu H, Chen T, Wang X, Wang FY. Evaluation of tourism development value of intangible culture heritage resources: a case study of Suzhou City. Prog Geogr. 2016;35(8):997–1007 (**in Chinese**).
14. Zhang XY, Li YJ, Lin J, Ye YJ. The construction of placeness in traditional handicraft heritage sites: a case study of Suzhou embroidery. Sustainability. 2021;13(16):9176–9176.
15. Li RR, Zhao W, Chen J. Structure and distribution of the intangible cultural heritage in Fujian. Areal Res Dev. 2014;33(6):97–102 (**in Chinese**).
16. Hu Z, Liu PL, Deng YY, Zheng WW, Qiu HD. Culture-Gene identification of intangible cultural heritage for Rucheng county of china: a case study of fiery dragon. Hum Geogr. 2015;30(1):64–69 (**in Chinese**).
17. Pu LC, Xiao L. A research on educational inheritance of the Epopee Ashima of Yi People. J Res Educ Ethnic Minor. 2016;27(4):137–144 (**in Chinese**).
18. How are the East, Central and West regions of China divided? (in Chinese) [EB/OL](2021-9-22) [2022-5-25].http://tjj.yq.gov.cn/tjzs/202109/t20210922_1220396.html.
19. Thitithep S, Kanyarat H. A simple method for estimating the Lorenz curve. Hum Soc Sci Commun. 2021;8(1):27.
20. Wu YJ, Wang FY. Study on the Spatial connectivity and distribution of the landscape for Maoershan Region in Heilongjiang Province. Adv Mater Res. 2014;3248(955–959):3987–3993.
21. Shi X. Selection of bandwidth type and adjustment side in kernel density estimation over in homogeneous backgrounds. Int J Geogr Inf Sci. 2010;24(5):643–660.
22. Wang JF, Li XH, Christakos G, Liao YL, Zhang TL, Gu X, Zheng XY. Geographical detectors-based health risk assessment and its application in the neural tube defects study of the Heshun Region, China. Int J Geogr Inf Sci. 2010;24(1):107–127.
23. Wang JF, Zhang TL, Fu BJ. A measure of spatial stratified heterogeneity. Ecol Ind. 2016;67:250–256.
24. Wang JF, Xu CD. Geodetector: principle and prospective. Acta Geogr Sin. 2017;1:116–134.
25. Li JM, Zhao QQ, Chen J. Spatial distribution characteristics and influencing factors of intangible cultural heritage in yangtze river economic belt. Econ Geogr. 2020;40(12):191–198 (**in Chinese**).
26. Xu BC, Pan JH. Spatial distribution characteristics of the intangible cultural heritage in China. Econ Geogr. 2018;38(05):188–196 (**in Chinese**).
27. Wang Q, Tang GD, Ma HQ, Li Z, Zhu LF. Geographical distribution of the intangible cultural heritage in Shanxi province. J Arid Land Resour Environ. 2019;33(10):185–193 (**in Chinese**).
28. Geospatial data cloud website. (in Chinese):http://www.gscloud.cn/#page1/1.
29. China's Economic and Social Big Data Research Platform. (in Chinese) https://data.cnki.net/Yearbook/Navi?type=type&code=A
30. Fredric RJ, Masao M. The cultures of globalization. Translated by Ma D. Nanjing: Nanjing University Press; 2001. p. 61. (in Chinese)
31. Jiang JL, Yang QY, Zhang ZX, Su KC. Spatial distribution pattern of intangible cultural heritage and tourism development in Chongqing. Econ Geogr. 2019;39(06):205–213 (**in Chinese**).

Publisher's Note
Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.